A FICTITIOUS DOMAIN METHOD WITH DISTRIBUTED LAGRANGE MULTIPLIER FOR PARTICULATE FLOWS

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In this article the numerical simulation of incompressible viscous flow around a free falling particle is discussed.

The fluid-body coupled analysis exists in the field of engineering. Even if it restricts to the field of civil engineering, such as beach drifting, scouring around the pier and sedimentation of the sand at the river mouth exist. These problems are caused by the force, which a particle receives from fluid (fluid force) or change of the effective stress between the particles accompanying change to the pressure in fluid. These problems do a lot of damage to our life. Thus, the fluid-body coupled analysis is a very important problem in the field of natural environment and engineering. But it is difficult to analyze the fluid–body coupled analysis by the conventional finite element method. This research applied the fictitious domain method to the fluid -body coupled analysis and shows free falling particle model, which exist in the fluid-body coupled analysis.

In recent years the finite element analysis carried out rapid developed. As the finite element analysis developed rapidly, complicated and large-scaled computational model containing the moving boundary and body are increased. But computation of such model arise many problems. The conventional finite element method had to be remesh to adjust the transformation of the computation domain in the moving boundary problem. Thus, in the computation of complicated and large-scaled computational model perpetual remeshing arise shortage of memory and increase of computational time.

But if the fictitious domain method is used, it is not necessary for remeshing and gets rid of the problems, which exists in the conventional method. Because the fictitious domain method uses two kind of the finite element mesh. One is the small mesh for moving particle, the other is the large mesh for whole computational domain. In the moving particle problem, the small mesh can move on a large the mesh without fitting a node. Therefore, the fictitious domain method can save memory amount and computational time become shorter.

In consideration of the above-mentioned, the fictitious domain method was applied to the numerical simulation of incompressible viscous flow around a free falling particle, which exist in the fluid–body coupled analysis.